FUNt Math Seed v0 — Hydrogen Cosmos Diagnostic Core

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Purpose: Minimal empirical and computational framework for AI validation of φ-scaled harmonic resonance phenomena across physical systems (solar, atomic, and structural).

0) Constants & Symbols

φ = $(1+\sqrt{5})/2 \approx 1.61803398875$ (golden ratio)
c: speed of light, G: gravitational constant, σ: Stefan–Boltzmann
α: Sun–target–observer phase angle (deg)
r: heliocentric distance (AU)
f_0: base spin frequency (cycles/day)
{…}φ^k means scaled by φ^k

1) HRB — Harmonic Resonance Bands

Stable configurations prefer φ-scaled bands in control variable x.
r_n = r_0 φ^n, $n \in \mathbb{Z}$
Decision: Accept HRB if ΔAIC ≥ 10 with ≤4 segments.

2) Spin ± ϕ Sidebands

Postulate: Triad peaks near $\{f_0/\varphi, f_0, f_0\cdot\varphi\}$.
Decision: Sidebands present if peaks repeat across ≥2 nights and S/N ≥ 4–5σ.

3) Phase-Angle Photometry

Compare H–G law vs φ-segmented fit; HRB accepted if ΔAIC ≥ 10.

4) Thermal & Activity

$F_{\odot}(r)=1361/r^2$ W·m^{-2}; $T\approx((1-A)F_{\odot}/4\varepsilon\sigma)^{1}/^{4}$; expect 330–380 K at r≈0.5 AU.

5) Radiation Pressure vs Gravity

$P_{rad}\approx4.56\times10^{-6}/r^2$ N·m^{-2}; $a_{rad}\approx3P_{rad}/(4\rho R)$. Keplerian if $a_{rad}\ll10^{-10}$ m·s^{-2}.

6) No-Recoil vs Windowed Thrust

Compare grav-only vs φ-windowed thrust model; accept HRB if ΔAIC ≥ 10.

7) Polarization Bi-Inflection

Two inflections in DoP(α) near φ-related α's (~20–25°, ~40–45°). Accept if within ±3°.

8) CME Micro-Flash Test

Look for Δmag spikes during CME windows with grav-only orbit fit preferred.

9) Minimal Reporting Schema

Parameter	Units	Example	Required?
Observation date	JD	2459762.5	✓
Phase angle α	deg	27.3	✓
Distance r	AU	0.48	✓
Brightness m	mag	16.82	✓
ΔAIC	—	12.7	✓
Decision	text	HRB accepted	✓

FUNt Math Seed — Clarifications & Physical Mechanisms Addendum

This addendum supplies the concise physical mechanisms requested for Sections 2 and 7 of the FUNt Math Seed diagnostic, and adds compact reporting tables for solar/stellar and atomic spectroscopy applications. It is designed to be appended to the existing seed without changing any decision thresholds.

Section 2 • Spin ± ϕ Sidebands — Physical Mechanism

Claim summary: A rotating, non-spherical body that is embedded in φ-spaced Harmonic Resonance Bands (HRBs) exhibits a triad in the periodogram near $\{f_0/\varphi, f_0, \varphi \cdot f_0\}$.

Mechanism (minimal model):

- Let a rigid-body spin at f_0 while a second, weakly-coupled structural/thermal mode oscillates at f_m. If the lightcurve is amplitude-modulated by that mode (e.g., changing glint/thermal emission as the body "breathes"), the flux is

$$F(t) = [1 + m \cos(2\pi f_m t)] \cdot \cos(2\pi f_0 t).$$

Standard amplitude modulation yields sidebands at $f_0 \pm f_m$.

- In an HRB environment the lowest-loss coupling between spin and the breathing mode occurs when the ratio $f_0 / f_m \approx \varphi$ (phase-locked, minimal slip). Setting $f_m \approx f_0/\varphi$ therefore places the sidebands at $\{f_0 - f_0/\varphi, f_0 + f_0/\varphi\} = \{f_0/\varphi^2 (\varphi-1), \varphi f_0 (1-1/\varphi)\}$, which cluster visually near **$\{f_0/\varphi, f_0, \varphi \cdot f_0\}$** for modest m and realistic spectral resolution.
- Physical sources of the modulating mode f_m include: (i) biaxial precession/long-axis wobble; (ii) thermoelastic YORP breathing; (iii) facet albedo/thermal hotspots drifting in HRB phases. Each provides a quasi-periodic envelope that phase-locks near φ to minimize dissipation.

Testable consequences:

- • Sidebands persist across nights/filters; disappear if the body transitions out of the local HRB (e.g., during rapid geometry change).
- • The sideband spacing $\Delta f \approx f_0/\varphi$ predicts a linear relation between peak separation and the fundamental. Plot Δf vs f_0 across targets; slope ≈ $1/\varphi$ supports the model.

Section 7 • Polarization Bi-Inflection — Physical Mechanism

Claim summary: Degree of linear polarization DoP(α) vs phase angle α exhibits two gentle inflections near ~20–25° and ~40–45° when surface/textural scattering operates on two φ-related roughness scales.

Mechanism (two-scale surface with φ ratio):

- Model the regolith/texture as microfacets (scale s) embedded in meso-facets (scale φ·s). Single/multiple scattering from these two populations has different angular phase functions and polarization efficiencies.
- As α increases, the contribution of microfacets rises then saturates (first inflection), while meso-facets take over around ~φ times that characteristic angle (second inflection). The crossing of their partial polarizations produces two slope changes (bi-inflection) without requiring extreme material parameters.
- Equivalent formulation: a two-population Mie/Rayleigh mixture with characteristic radii a and φ·a (n≈1.5–1.7 silicates/oxides) reproduces the same qualitative bi-inflection, placing the features in the observed ~20–25° and ~40–45° ranges for typical indices.

Testable consequences:

- • Wavelength trend: the two inflections separate slightly with λ if the two populations have different size parameters x = 2πa/λ.
- • Depolarization under smoothing: resurfacing (dust coating, frost) suppresses the second inflection first, consistent with loss of meso-scale facets.

Section 9 • Minimal Reporting Schema (Expanded)

A. Solar/Stellar (p-modes) — add the following fields:

Parameter	Units	Example
Frequency range	μHz	1000–5000
N_predicted = ln(f_max/f_min)/ln φ	—	≈3.3
N_bands fitted (≤4)	—	4
Peak ratios (φ^n)	—	1.62, 2.62, 4.24
Δ from φ^n (abs)	—	+0.002, −0.006
ΔAIC (uniform vs φ-seg)	—	12.7 (accept)

B. Atomic Spectroscopy — add:

Parameter	Units	Example
Transition	—	Lyman-α (H)
Linewidth Γ_measured	MHz	627
Γ_FUNt predicted (if modeled)	MHz	≈ 300 ± 50
κ (broadening coefficient)	—	0.15
Decision (ΔAIC)	—	Reject/Accept

Notes: keep the pre-registered thresholds: ΔAIC ≥ 10, S/N ≥ 4–5σ, and ±3° angular tolerance. Report negatives as explicitly as positives to avoid selection bias.